Ryzen

Ryzen (/ˈraɪzən/, *RY-zən*)[5] is a brand[6] of multi-core x86-64 microprocessors designed and marketed by Advanced Micro Devices (AMD) for desktop, mobile, server, and embedded platforms based on the Zen microarchitecture. It consists of central processing units (CPUs) marketed for mainstream, enthusiast, server, and workstation segments and accelerated processing units (APUs) marketed for mainstream and entry-level segments and embedded systems applications.

Ryzen 3 PRO 2100GE[4] found in some OEM markets in limited quantities

A majority of AMD's consumer Ryzen products use the AM4 platform. In August 2017, AMD launched their **Ryzen Threadripper** line aimed at the enthusiast workstation market. Ryzen Threadripper uses different, larger sockets such as TR4, sTRX4, and sWRX8, which support additional memory channels and PCI Express lanes. AMD has moved to the new AM5 platform for consumer desktop Ryzen with the release of Zen 4 products in late 2022.

History

AMD Ryzen 7 3700X

AMD announced a new series of processors on 13 December 2016, named "Ryzen", and delivered them in Q1 2017,[6] the first of several generations. The 1000 series featured up to eight cores and 16 threads, with a +52 percent instructions per cycle (IPC) increase over their prior CPU products, namely AMD's previous Excavator microarchitecture.[7]

The second generation of Ryzen processors, the Ryzen 2000 series, released in April 2018, featured the Zen+ microarchitecture. The aggregate performance increased +10 percent (of which approximately +3 percent was IPC and +6 percent clock frequency.[8][9] Most importantly, Zen+ fixed the cache and memory latencies that had been major weak points.[10]

The third generation of Ryzen processors launched on 7 July 2019, based on AMD's Zen 2 architecture, featuring significant design improvements with a +15 percent average IPC boost, a doubling of floating point capability to a full 256-bit-wide execution data path much like Intel's Haswell released in 2014,[11] a shift to an multi-chip module (MCM) style "chiplet" based package design, and a further shrink to Taiwan Semiconductor Manufacturing

Ryzen	
General information	
Launched	March 2, 2017[1]
Marketed by	AMD
Designed by	AMD
Common manufacturer(s)	GlobalFoundries (14 nm and 12 nm only) TSMC (7 nm and beyond)
Performance	
Max. CPU clock rate	3.0 GHz to 5.7 GHz
HyperTransport speeds	800 MT/s to 2 GT/s
Cache	
L1 cache	**Zen/Zen+**: 96 KB per core (32 KB instructions + 64 KB data) **Zen 2–present**: 64 KB per core (32 KB instructions + 32 KB data)
L2 cache	**Zen–Zen 3**: 512 KB per core **Zen 4–present**: 1 MB per core
L3 cache	**Desktop and mobile**: 2 - 64 MB (or 96 MB/ 128 MB with 3D V-Cache

	HEDT/Workstation: 32 MB - 384 MB
Architecture and classification	
Technology node	14 nm to 5 nm
Microarchitecture	**Zen microarchitecture**: Zen Zen+ Zen 2 Zen 3 Zen 3+ Zen 4
Instruction set	**Main processor**: x86-64 MMX(+), SSE1, SSE2, SSE3, SSSE3, SSE4a, SSE4.1, SSE4.2, AVX, AVX2, AVX-512 with Zen 4, FMA3, CVT16/F16C, ABM, BMI1, BMI2 AES, CLMUL, RDRAND, SHA, SME AMD-V, AMD-Vi AMD Platform Security Processor: ARM Cortex-A5
Physical specifications	
Transistors	4.8 billion for Zen & Zen+ (per 14/12 nm 8-core "Zeppelin" die) [1] 5.89 billion (1× CCD) or 9.69 billion (2× CCD) for Zen 2

	(3.8 billion per 7 nm 8-core "CCD" & 2.09 billion for the 12 nm "I/O die")[2] 6.24 billion (1x CCD) or 10.39 billion (2x CCD) for Zen 3 (4.15 billion per 7 nm 8-core "CCD" & 2.09 billion for the same 12 nm "I/O die")[3]
Cores	Mainstream: 4-16 cores HEDT: 8-64 cores Workstation: Up to 12-96 cores
GPU(s)	Radeon Graphics on APUs
Socket(s)	**Mainstream desktop** AM4 AM5 **High-end desktop and workstation** TR4 sTRX4 sWRX8 sTR5
Variant(s)	Athlon (low-end mobile) Epyc (server and embedded)
History	
Predecessor(s)	A-Series FX

Company's (TSMC) 7nm process fabrication process.

On 16 June 2020 AMD announced new Ryzen 3000XT series processors with increased boost clocks and other performance enhancements compared to X processors.[12]

On 8 October 2020 AMD announced the Zen 3 architecture for their Ryzen 5000 series processors, featuring a +19 percent IPC improvement over Zen 2, while being built on the same 7 nm TSMC node with out-of-the-box operating boost frequencies exceeding 5 GHz for the first time since AMD's Piledriver.[13] This was followed by an unusually short stop-gap release of Ryzen 6000 mobile-only series processors on 4 January 2022, using the modestly changed Zen 3+ core on a 6nm process by TSMC, with claims up to +15 percent performance uplift gains from frequency rather than IPC.[14]

The Ryzen 7000 series was released 27 September 2022 for desktops, featuring the new Zen 4 core with a +13 percent uplift in IPC and +15 percent increase in frequency for a claimed nearly +30 percent in single thread performance.[15] The Ryzen 7000 series also features a brand new AM5 socket that only supports DDR5 SDRAM.

In mid 2024, AMD confirms to announce a new grounds-up redesign of Ryzen named "Zen5" stemming from a leaked slide by Zen father and legendary chip architect Jim Keller who worked with AMD to release the first Ryzen chips in 2017. Jim Keller, leading the new RISC-V team at Tenstorrent, claims absolute dominance in integer performance in a specific INTSPEC benchmark slide which was taken down.

Ryzen is the consumer-level implementation of the newer Zen microarchitecture, a complete redesign that marked the return of AMD to the high-end central processing unit (CPU) market, offering a product range capable of competing with Intel.[16][17] Having more processing cores, Ryzen processors offer greater multi-threaded performance at the same price point relative to Intel's Core processors.[18] The Zen architecture delivers more than +52 percent improvement in instructions per cycle (clock) over the prior-generation Bulldozer AMD core, without raising electrical power use.[7] The changes to the instruction set architecture also adds binary-code compatibility to AMD's CPU.[19]

Threadripper series

Ryzen Threadripper logo

Threadripper, which is geared for high-end desktops (HEDT) and professional workstations, was not developed as part of a business plan or a specific roadmap. Instead, a small team inside AMD saw an opportunity to develop the benefits of Ryzen and EPYC CPU roadmaps, so as to give AMD the lead in desktop CPU performance. After some progress was made in their spare time, the project was greenlit and put in an official roadmap by 2016.[20]

Ryzen AI

Ryzen AI is the brand name for AMD's hardware implementation of its XDNA AI accelerator on consumer Ryzen processors, as well as the driver software supporting it. Introduced on the Ryzen 7040 mobile series in mid 2023, it can be used to run AI applications such as camera background effects, voice recognition, photo artifact removal and skin smoothing.[21] These tasks are normally run on the CPU cores, but doing so uses a significant amount of energy with a large thermal footprint. An AI accelerator is a chip that is built to run certain tasks efficiently, similar to a video decoder.[22]

Software support for Microsoft Windows was made widely available in December 2023,[23] while software support for Linux was introduced in January 2024.[24]

Ryzen AI is not to be confused with XDNA, which is AMD's name for its AI accelerator architecture, based on intellectual property from AMD's acquisition of Xilinx.[22]

Product lineup

Ryzen 1000

Desktop

- Socket AM4 for Ryzen and Socket TR4 for Ryzen Threadripper.[25][26]
- Based on first generation Zen. Ryzen CPUs based on Summit Ridge architecture. Threadripper based on Whitehaven architecture.

- 4.8 billion transistors per 192 mm^2[27] 8-core "Zeppelin" die[1] with one die being used for Ryzen and two for Ryzen Threadripper.
- Stepping: B1[28]
- Memory support:
  - Ryzen dual-channel: DDR4–2666 ×2 single rank, DDR4–2400 ×2 dual rank, DDR4–2133 ×4 single rank, or DDR4–1866 ×4 dual rank.[25][29]
  - Ryzen Threadripper quad-channel: DDR4–2666 ×4 single rank, DDR4–2400 ×4 dual rank, DDR4–2133 ×8 single rank, or DDR4–1866 ×8 dual rank.
- Instructions sets: x87, MMX, SSE, SSE2, SSE3, SSSE3, SSE4.1, SSE4.2, AES, CLMUL, AVX, AVX2, FMA3, CVT16/F16C, ABM, BMI1, BMI2, SHA.[19]
- All Ryzen-branded CPUs (except PRO variants) feature unlocked multipliers.
- AMD's SenseMI Technology monitors the processor continuously and uses Infinity Control Fabric to offer the following features:[25][30][31]
  - Pure Power reduces the entire ramp of processor voltage and clock speed, for light loads.
  - Precision Boost increases the processor voltage and clock speed by 100–200 MHz if three or more cores are active (five or more, in the case of Threadripper, and by 300 MHz); and significantly further when less than three are active (less than five, in the case of Threadripper).[32]
  - XFR (eXtended Frequency Range) aims to maintain the average clock speed closer to the maximum Precision Boost, when sufficient cooling is available.[33]
  - Neural Net Prediction and Smart Prefetch use perceptron based neural branch prediction inside the processor to optimize instruction workflow and cache management.
- Ryzen launched in conjunction with a line of stock coolers for Socket AM4: the Wraith Stealth, Wraith Spire and Wraith Max. This line succeeds the original AMD Wraith cooler, which was released in mid-2016.[34] The Wraith Stealth is a bundled low-profile unit meant for the lower-end CPUs with a rating for a TDP of 65 W, whereas the Wraith Spire is the bundled mainstream cooler with a TDP rating of 95 W, along with optional RGB lighting on certain models. The Wraith Max is a larger cooler incorporating heatpipes, rated at 140 W TDP.
- In December 2019, AMD started producing first generation Ryzen products built using the second generation Zen+ architecture.[35] An example is the Ryzen 5 1600, with new batches having an "AF" identifier instead of its usual "AE", essentially being an underbinned Ryzen 5

2600 with the same specifications as the original Ryzen 5 1600.

Overview of desktop Ryzen 1000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen Threadripper 1000	Whitehaven	Zen (1st gen)	8–16	none
Ryzen 1000 / 1000X	Summit Ridge		4–8	

Ryzen 2000

Desktop

The first Ryzen 2000 CPUs, based on the 12 nm Zen+ microarchitecture, were announced for preorder on April 13, 2018[36] and launched six days later. Zen+ based Ryzen CPUs are based on Pinnacle Ridge architecture,[37] while Threadripper CPUs are based on the Colfax architecture. The first of the 2000 series of Ryzen Threadripper products, introducing Precision Boost Overdrive technology,[33] followed in August. The Ryzen 7 2700X was bundled with the new Wraith Prism cooler.

In January 2018, AMD announced the first two Ryzen desktop APUs with integrated Radeon Vega graphics under the Raven Ridge codename. These were based on first generation Zen architecture. The Ryzen 3 2200G and the Ryzen 5 2400G were released in February.[38]

Overview of desktop Ryzen 2000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen Threadripper 2000	Colfax	Zen+	12–32	none
Ryzen 2000 / 2000X	Pinnacle Ridge		4–8	
Ryzen 2000G	Raven Ridge	Zen (1st gen)	4	Radeon Vega (GCN 5), up to 11 CU

Mobile

In May 2017, AMD demonstrated a Ryzen mobile APU with four Zen CPU cores and Radeon Vega GPU.[39] The first Ryzen mobile APUs, codenamed Raven Ridge, were officially released in October 2017.[40]

- 4.95 billion[41] transistors on a 210 mm^2 die,[41] based on a modified 14 nm Zeppelin die where four of the cores are replaced by an integrated fifth-generation GCN-based GPU.
- Precision Boost 2[37]

- 16 external PCIe 3.0 lanes (four each to chipset and M.2 socket; eight to a PCIe slot). 16 internal PCIe 3.0 lanes for the integrated GPU and on-board input/output (I/O). In 2019, AMD released some new dual core Zen mobile parts branded as 300 or 3000, codenamed Dali.

Overview of laptop Ryzen 2000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 2000	Raven Ridge	Zen (1st gen)	2–4	Radeon Vega (GCN 5), up to 11 CU

Embedded

Great Horned Owl

In February 2018 AMD announced the V1000 series of embedded Zen+ Vega APUs, based on the Great Horned Owl architecture, with four SKUs.[42]

Banded Kestrel

In April 2019 AMD announced another line of embedded Zen+ Vega APUs, namely the Ryzen Embedded R1000 series with two SKUs.[43]

Ryzen 3000

Desktop

On 27 May 2019 at Computex in Taipei, AMD launched its third generation Ryzen processors which use AMD's Zen 2 architecture. For this generation's microarchitectures, Ryzen uses *Matisse*, while Threadripper uses *Castle Peak*. The chiplet design separates the CPU cores, fabricated on TSMC's 7FF process, and the I/O, fabricated on GlobalFoundries' 12LP process, and connects them via Infinity Fabric.[44] The Ryzen 3000 series uses the AM4 socket similar to earlier models and is the first CPU to offer PCI Express 4.0 (PCIe) connectivity.[45] The new architecture offers a 15% instruction-per-clock (IPC) uplift and a reduction in energy usage. Other improvements include a doubling of the L3 cache size, a re-optimized L1 instruction cache, a larger micro-operations cache, double the AVX/AVX2 bandwidth, improved branch prediction, and better instruction pre-fetching.[44] The 6, 8 and 12 core CPUs became generally available on 7 July 2019, and 24 core processors were launched in November.[46]

The competing Intel Core i9-10980XE processor has only 18 cores and 36 threads. Another competitor, the workstation-oriented Intel Xeon W-3275 and W-3275M, has 28 cores, 56 threads, and cost more when launched.

The 4, 6 and 8 core processors have one core chiplet. The 12 and 16 core processors have two core chiplets. In all cases the I/O die is the same.[44]

The Threadripper 24 and 32 core processors have four core chiplets. The 64 core processor has eight core chiplets. All Threadripper processors use the same I/O die.

Both mobile and desktop APUs are based on the Picasso microarchitecture, a 12 nm refresh of Raven Ridge, offering a modest (6 percent) increase in clock speeds (up to an additional 300 MHz maximum boost), Precision Boost 2, an up to 3 percent increase in IPC from the move to the Zen+ core with its reduced cache and memory latencies, and newly added solder thermal interface material for the desktop parts.[47] Fabricated at GlobalFoundries, This gives the Ryzen 12nm (Zen+ refresh) from the "original" 14nm Zen cores initially released in 2017 an aggregate 10 percent performance uplift going from 14nm to 12nm.

Overview of desktop Ryzen 3000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen Threadripper PRO 3000	Castle Peak	Zen 2	12–64	none
Ryzen Threadripper 3000			24–64	
Ryzen 3000 / 3000X	Matisse		4–16	
Ryzen 3000G	Picasso	Zen+	4	Radeon Vega (GCN 5), up to 11 CU

Mobile

In 2019, AMD first released the Ryzen 3000 APUs, consisting only of quad core parts. Then in January 2020, they announced value dual-core mobile parts, codenamed Dalí, including the Ryzen 3 3250U and lower-end Athlon-branded parts.

Overview of laptop Ryzen 3000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 3000	Picasso	Zen+	2–4	Radeon Vega (GCN 5), up to 11 CU
Ryzen 3 3250U, Ryzen 3 3200U	Dali	Zen (1st gen)	2	Radeon Vega (GCN 5), 3 CU

Ryzen 4000

Desktop

The Ryzen 4000 APUs are based on Renoir, a refresh of the Zen 2 Matisse CPU cores, coupled with Radeon Vega GPU cores. They were released only to OEM manufacturers in mid-2020. Unlike Matisse, Renoir does not support PCIe 4.0.[48]

Ryzen Pro 4x50G APUs are the same as 4x00G APUs, except they are bundled a Wraith Stealth cooler and are not OEM-only.[49] It is possible this is a listing mistake, since 4x50G CPUs are unavailable on retail (as of Oct. 2020) and PRO SKUs are usually the OEM only parts.

In April 2022, AMD released the Ryzen 5 4600G to retail, and launched the Ryzen 4000 series of CPUs without integrated graphics, for budget-oriented users.[50] Unlike the Ryzen 3000 series CPUs which are based on *"Matisse"* cores, these new Ryzen 4000 series desktop CPUs are based on *"Renoir"* cores and are essentially APUs with the integrated graphics disabled.

Overview of desktop Ryzen 4000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 4000	Renoir	Zen 2	4–6	none
Ryzen 4000G			4–8	Radeon Vega (GCN 5), up to 8 CU

Mobile

Zen 2 APUs, based on the 7 nm Renoir microarchitecture, commercialized as Ryzen 4000.[51][52][53]

Overview of laptop Ryzen 4000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 4000	Renoir	Zen 2	4–8	Radeon Vega (GCN 5), up to 8 CU

Embedded

Grey Hawk

In November 2020, AMD announced the V2000 series of embedded Zen 2 Vega APUs.

Ryzen 5000

Desktop

The desktop Ryzen 5000 series, based on the Zen 3 microarchitecture, was announced on October 8, 2020.[54][55] They use the same 7 nm manufacturing process, which has matured slightly.[56] Mainstream Ryzen 5000 CPUs are codenamed *Vermeer*. Enthusiast/workstation Threadripper 5000 CPUs are codenamed *Chagall*,[57] initially named Ryzen Threadripper 4000 under the codename *Genesis*.[58]

In contrast to their CPU counterparts, the APUs consist of single dies with integrated graphics and smaller caches. The APUs, codenamed Cezanne, forgo PCIe 4.0 support to keep power consumption low.[59]

Overview of desktop Ryzen 5000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen Threadripper PRO 5000	Chagall	Zen 3	12–64	none
Ryzen 5000 / 5000X / 5000X3D	Vermeer		6–16	
Ryzen 7 5700, Ryzen 5 5500, Ryzen 3 5100	Cezanne		4–8	
Ryzen 5000G				Radeon Vega (GCN 5), up to 8 CU

Mobile

The 5000 series includes models based on the Zen 2 microarchitecture (codename *Lucienne*) and Zen 3 microarchitecture. The codenames of the Zen 3-based mobile APUs are *Cezanne* for the 2021 models and *Barceló* for the 2022 models. HX models are unlocked, allowing them to be overclocked if the host device manufacturer has exposed that functionality. Simultaneous multithreading (SMT) is now standard across the lineup unlike the 4000-series Ryzen Mobile.

Overview of laptop Ryzen 5000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 7 5700U, Ryzen 5 5500U, Ryzen 3 5300U	Lucienne	Zen 2	4-8	Radeon Vega (GCN 5), up to 8 CU
Ryzen 5000	Cezanne	Zen 3	4-8	
	Barcelo		2-8	

Ryzen 6000

Mobile

At CES 2022, AMD announced the Ryzen 6000 mobile series. It is based on the Zen 3+ architecture, which is Zen 3 on 6nm with efficiency improvements, and is codenamed *Rembrandt*. Other noteworthy upgrades are RDNA2 based graphics, PCIe 4.0 and DDR5/LPDDR5 support. Ryzen PRO versions of these processors were announced on April 19, 2022[60] and use a 6x50 naming scheme.

Overview of laptop Ryzen 6000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 6000	Rembrandt	Zen 3+	6–8	Radeon 6x0M (RDNA 2), up to 12 CU

Ryzen 7000

Desktop

AMD Ryzen 9 7900X processor

In May 2022 AMD revealed its roadmap showing the Ryzen 7000 series of processors for release later that year, to be based on the Zen 4 architecture in 5 nm (codenamed *Raphael*).[61][62] Included are DDR5 and PCIe 5.0 support as well as the change to the new AM5 socket. On 23 May 2022 at AMD's Computex keynote, AMD officially announced the Ryzen 7000 to be released in Fall 2022, showing a 16-core CPU reaching boost speeds of 5.5 GHz and claiming a 15 percent increase in single-thread performance.[63] The initial four models of the Ryzen 7000 series, ranging from Ryzen 5 7600X to Ryzen 9 7950X, were launched on September 27, 2022.[64]

The L2 cache per core is doubled to 1 MB from Zen 3. The I/O die has moved from a 12 nm process to 6 nm and incorporates an integrated RDNA 2 GPU with two CUs on all Ryzen 7000

models (except the Ryzen 5 7500F), as well as DDR5 and PCIe 5.0 support.[65][66] DDR4 memory is not supported on Ryzen 7000. According to Gamers Nexus, AMD said that the RDNA GPU was intended for diagnostic and office purposes without using a discrete GPU and not for gaming.[67] The operating power of AM5 is increased to 170 W from AM4's 105 W, with the absolute maximum power draw or "Power Package Tracking" (PPT) being 230 W.[68]

The Ryzen Threadripper and Threadripper PRO 7000 series were released on November 21, 2023. Threadripper features up to 64 cores, while Threadripper PRO 7000 features up to 96 cores. These new HEDT and workstation processor lineups both utilize a new socket, sTR5, as well as DDR5 and PCIe 5.0. Two new chipsets have been introduced for the sTR5 socket: TRX50 and WRX90.[69][70]

Overview of desktop Ryzen 7000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen Threadripper PRO 7000	Storm Peak	Zen 4	12–96	none
Ryzen Threadripper 7000			24–64	
Ryzen 7000 / 7000X / 7000X3D	Raphael		6–16	Radeon (RDNA 2), 2 CU

Mobile

The **Ryzen 7000** mobile series initially launched in September 2022 with the Ryzen 7020 *Mendocino* line of low-end Zen 2 ultra mobile processors.[71]

In early 2023, the rest of the Ryzen 7000 mobile lineup was released, starting with Ryzen 7030, Ryzen 7035, and later Ryzen 7045 and Ryzen 7040 series processors.

The *Ryzen 7020* series targets the "everyday computing" segment.[72] It is a new Zen 2 design based on 6 nm process and RDNA 2 integrated graphics.

The *Ryzen 7030* series is a refresh of Ryzen 5000 series processors codenamed "Barcelo-R",[73] targeting the "mainstream thin-and-light" segment.[72]

The *Ryzen 7035* series is a refresh of Ryzen 6000 series processors codenamed "Rembrandt-R", [73] targeting "premium thin-and-light" laptops.[72]

The *Ryzen 7040* series is a new design based on Zen 4, targeting "elite ultrathin" segment.[72] It integrates a built-in AI accelerator (branded as "Ryzen AI") for the first time in an AMD processor, [74] and features RDNA 3 integrated graphics with up to 12 compute units.

The *Ryzen 7045* series is the top of the range, based on Zen 4. It targets "extreme gaming and creator" laptops, i.e. desktop replacement class laptops,[72] with models providing up to 16 cores. It uses a chiplet package built using a separate CCD and I/OD, the same as those used in Raphael desktop processors.[75]

Altogether, there are four different CPU architectures, and three different GPU architectures used across the various models in the 7000 series lineup.[76]

With the launch of the mobile Ryzen 7000 series, a new CPU model naming system was also introduced, which is used with Ryzen and Athlon mobile processors launching from this point onwards, as follows:[77]

Ryzen/Athlon *xabc*:

- x – timeline of creation (7 for 2022, 8 for 2023, etc)
- a – performance segment (1 for low end, 7 for high-end, 9 for enthusiast, etc)
- b – Microarchitecture the processor is based on (1 for Zen / Zen+, 3 for Zen 3 / 3+, 4 for Zen 4, 5 for Zen 5, etc)
- c – feature / minor performance segment (0 for lower segment, 5 for higher segment)

The new naming system has drawn criticism for being overly complex and confusing to consumers.[78][79] Desktop processors continue to use the old naming system.[80]

Overview of laptop Ryzen 7000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 7045	Dragon Range	Zen 4	6–16	Radeon 610M (RDNA 2), 2 CU
Ryzen 7040	Phoenix		4–8	Radeon 7x0M (RDNA 3), up to 12 CU
Ryzen 7035	Rembrandt-R	Zen 3+		Radeon 6x0M (RDNA 2), up to 12 CU
Ryzen 7030	Barcelo-R	Zen 3		Radeon Vega (GCN 5), up to 8 CU
Ryzen 7020	Mendocino	Zen 2	4	Radeon 610M (RDNA 2), 2 CU

Ryzen 8000

Desktop

On January 8, 2024, AMD announced the Ryzen 8000G series of desktop APUs for the AM5 socket at the 2024 Consumer Electronics Show. These APUs are based on Zen 4 and feature up to 12 CUs of RDNA3 integrated graphics. Furthermore, the upper-end models such as Ryzen 5

8600G and Ryzen 7 8700G feature "Ryzen AI", which is a neural processing unit (NPU) for artificial intelligence PC applications.[81] AMD claims that the integrated graphics in Ryzen 8000G APUs is capable of playing AAA games such as Cyberpunk 2077 and Far Cry 6 at 1080p low settings.[82]

On April 1, 2024, AMD quietly released Ryzen 8000 series processors without integrated graphics, which also use the Zen 4 architecture. These processors are essentially based on the Ryzen 8000G series but with the integrated graphics and NPU disabled. The Ryzen 7 8700F however can provide AI acceleration when paired with a Radeon discrete GPU that supports it.[83]

Overview of desktop Ryzen 8000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 8000	Phoenix	Zen 4	6–8	none
Ryzen 8000G			4–8	Radeon 7x0M (RDNA 3), up to 12 CU

Mobile

A refresh of Ryzen 7040 mobile processors named the Ryzen 8040 and 8045 series were announced on December 6, 2023.[84] These processors feature small firmware and software optimizations for performance and have up to 1.4x faster NPU performance (6 TOPS higher) compared to Ryzen 7040.[85]

Overview of mobile Ryzen 8000 series models

Model line	Codename	Architecture	Core count	Integrated graphics
Ryzen 8045 *Ryzen 8040*	Hawk Point	Zen 4	4–8	Radeon 7x0M (RDNA 3), up to 12 CU

Ryzen 9000

Upcoming desktop and mobile Ryzen processors utilizing the Zen 5 microarchitecture are expected to use *Ryzen 9000* naming,[86] with release anticipated in mid to late 2024.[87]

Initial reception

The first Ryzen 7 (1700, 1700X, and 1800X) processors debuted in early March 2017 and were generally well received by hardware reviewers.[88][89][90] Ryzen was the first brand new architecture from AMD in five years, and without very much initial fine-tuning or optimization, it

ran generally well for reviewers.[91] Initial Ryzen chips ran well with software and games already on the market, performing exceptionally well in workstation scenarios, and well in most gaming scenarios. Compared to Piledriver-powered FX chips, Zen-powered Ryzen chips ran cooler, much faster, and used less power. IPC uplift was eventually gauged to be 52 percent higher than Excavator, which was two full generations ahead of the architecture still being used in AMD's FX-series desktop predecessors like the FX-8350 and FX-8370.[1] Though Zen fell short of Intel's Kaby Lake in terms of IPC, and therefore single-threaded throughput, it compensated by offering more cores to applications that can use them. Power consumption and heat emission were found to be competitive with Intel, and the included Wraith coolers were generally competitive with higher-priced aftermarket units.

Ryzen 7 1800X's multi-threaded performance, in some cases while using Blender or other open-source software, was around four times the performance of the FX-8370, or nearly double that of the Core i7-7700K.[92] One reviewer found that Ryzen chips would usually outperform competing Intel's Core i7 processors for a fraction of the price when all eight cores are used.[92]

However, one complaint among a subset of reviewers was that Ryzen processors lagged behind their Intel counterparts when running older games, or some newer games at mainstream resolutions such as 720p or 1080p.[93] AMD acknowledged the gaming performance deficit at low resolutions during a Reddit "Ask Me Anything" thread, where it explained that updates and patches were being developed.[94] Subsequent updates to *Ashes of the Singularity: Escalation* and *Rise of the Tomb Raider* increased frame rates by 17-31 percent on Ryzen systems.[95][96] In April 2017, developer id Software announced that, in the future, its games would exploit the greater parallelism available on Ryzen CPUs.[97]

It has been suggested that low threaded applications often result in Ryzen processors being underused, yielding lower than expected benchmark scores, because Zen relies on its core count to make up for its lower IPC rating than that of Kaby Lake.[98][99][100] However, AMD and others have argued thread scheduling is not the fundamental issue to Windows 10 performance.[101][102] Early AM4 motherboards were also hindered by BIOS bugs and poor DDR4 memory support.

Operating system support

Windows

AMD verified that computers with Ryzen CPUs can boot Windows 7 and Windows 8 both 64- and 32-bit but on newer hardware, including AMD Ryzen and Intel Kaby Lake and later, Microsoft only

officially supports the use of Windows 10. Windows Update blocks updates from being installed on newer systems running older versions of Windows, though that restriction can be circumvented with an unofficial patch.[103] Windows 11 is only officially supported on Ryzen APUs and CPUs using Zen+ architecture or newer; systems running Zen architecture-based CPUs or APUs are not entitled to receive updates.[104][105][106]

Although AMD initially announced that Ryzen chipset drivers would not be provided for Windows 7,[107] its chipset driver packages do in fact list and include them.[108]

Linux

Full support for Ryzen processors' performance features in Linux requires kernel version 4.10 or newer.[109]

Known issues

Spectre

Like nearly all modern high performance microprocessors, Ryzen was susceptible to the "Spectre" vulnerabilities. The vulnerabilities can be mitigated without hardware changes via microcode updates and operating system workarounds, but the mitigations incur a performance penalty.[110] Ryzen and Epyc suffer up to 20 percent penalty from the mitigations,[111] depending on workload, comparing favorably with a penalty of in some benchmarks up to 30 percent for Intel Core and Xeon processors,[112][113] in part as a result of the AMD processors not requiring mitigation against the related Meltdown vulnerability.[114]

Launched in 2019, Zen 2 includes hardware mitigations against the Spectre V4 speculative store bypass vulnerability.[44][115]

Segmentation fault

Some early shipments of Ryzen 1000 series processors produced segmentation faults on some workloads on Linux, especially while compiling code with GNU Compiler Collection (GCC).[116] AMD offered to replace the affected processors with newer ones that are unaffected by the problem.[117]

Alleged issues by CTS Labs

In early 2018, Israeli computer security consultancy firm CTS Labs stated that they had discovered several major flaws in the Ryzen components ecosystem,[118] publicly disclosing them after giving AMD 24 hours to respond and raising concerns and questions regarding their legitimacy,[119][120] though they were later confirmed by two separate security firms.[121] AMD has since stated that while the flaws are real and will be fixed via microcode updates, their severity was overstated as physical access to the hardware is required to exploit the flaws.[122]

See also

- Athlon
- AMD Accelerated Processing Unit
- List of AMD processors
- List of AMD Athlon processors
- List of AMD Epyc processors
- List of AMD FX processors
- List of AMD Opteron processors
- List of AMD Phenom processors
- List of AMD Ryzen processors

References

1. Cutress, Ian (February 22, 2017). "AMD Launches Ryzen: 52% More IPC, Eight Cores for Under $330, Pre-order Today, On Sale March 2nd" (http://www.anandtech.com/show/11143/amd-launch-ryzen-52-more-ipc-eight-cores-for-under-330-preorder-today-on-sale-march-2nd) . *AnandTech*. Retrieved November 18, 2022.
2. "Zen 2 - Microarchitectures - AMD" (https://en.wikichip.org/wiki/amd/microarchitectures/zen_2) . *WikiChip*. Retrieved June 14, 2020.
3. Demerjian, Charlie (November 7, 2020). "A long look at AMD's Zen 3 core and chips" (https://semiaccurate.com/2020/11/07/a-long-look-at-amds-zen-3-core-and-chips/) . *SemiAccurate*. Retrieved February 1, 2021.

4. "AMD Ryzen 3 PRO @ 3138.55 MHz - CPU-Z VALIDATOR" (https://valid.x86.fr/2193dv) . *valid.x86.fr*. Retrieved 2022-12-14.
5. Cutress, Ian (13 December 2016). "AMD Gives More Zen Details: Ryzen, 3.4 GHz+, NVMe, Neural Net Prediction, & 25 MHz Boost Steps" (http://www.anandtech.com/show/10907/amd-gives-more-zen-details-ryzen-34-ghz-nvme-neural-net-prediction-25-mhz-boost-steps) . AnandTech. Retrieved 18 November 2022.
6. "AMD Takes Computing to a New Horizon with Ryzen Processors" (https://www.amd.com/en/press-releases/amd-takes-computing-2016dec13) . *AMD* (Press release). Austin, TX. December 13, 2016. Archived (https://web.archive.org/web/20161214181758/https://www.amd.com/en-us/press-releases/Pages/amd-takes-computing-2016dec13.aspx) from the original on December 14, 2016. Retrieved 20 July 2018.
7. Cutress, Ian (22 February 2017). "AMD Launches Ryzen: 52% More IPC, Eight Cores for Under $330, Pre-order Today, On Sale March 2nd" (https://www.anandtech.com/show/11143/amd-launch-ryzen-52-more-ipc-eight-cores-for-under-330-preorder-today-on-sale-march-2nd) . AnandTech. Retrieved 5 August 2022.
8. Cutress, Ian (19 April 2018). "The AMD 2nd Gen Ryzen Deep Dive: The 2700X, 2700, 2600X, and 2600 Tested" (https://www.anandtech.com/show/12625/amd-second-generation-ryzen-7-2700x-2700-ryzen-5-2600x-2600) . AnandTech. Retrieved August 18, 2021.
9. Cutress, Ian (19 April 2018). "The AMD 2nd Gen Ryzen Deep Dive: The 2700X, 2700, 2600X, and 2600 Tested" (https://www.anandtech.com/show/12625/amd-second-generation-ryzen-7-2700x-2700-ryzen-5-2600x-2600) . AnandTech. Retrieved December 11, 2019.
10. Cutress, Ian (April 13, 2018). "AMD Ryzen 2nd Gen Details: Four CPUs, Pre-Order Today, Reviews on the 19th" (https://www.anandtech.com/show/12642/amd-ryzen-2nd-gen-details-4-skus-reviews-19th) . AnandTech. Retrieved 13 April 2018.
11. Walton, Steven (16 November 2020). "AMD Ryzen 5000 IPC Performance Tested" (https://www.techspot.com/article/2143-ryzen-5000-ipc-performance/) . TechSpot. Retrieved 18 August 2021.
12. Loeffler, John (16 June 2020). "New AMD Ryzen 3000 XT processors are coming one year after the originals" (https://www.techradar.com/news/new-amd-ryzen-3000-xt-processors-are-coming-one-year-after-the-originals) . TechRadar. Retrieved February 6, 2021.
13. Alcorn, Paul (November 26, 2020). "AMD Ryzen 9 5950X and 5900X Review: Zen 3 Breaks the 5 GHz Barrier" (https://www.tomshardware.com/reviews/amd-ryzen-9-5950x-5900x-zen-3-review) . Tom's Hardware. Retrieved 18 August 2021.
14. Sandhu, Tarinder (February 17, 2022). "Deep dive into AMD Ryzen 6000 Series mobile technology" (https://www.club386.com/deep-dive-into-amd-ryzen-6000-series-mobile-technology/) . Club386. Retrieved November 9, 2022.

15. Ganti, Anil (30 August 2022). "AMD Ryzen 7000 series of processors unleashed with new Zen 4 architecture, 13 percent IPC uplift, up to 170 W TDP, and an attractive price tag" (https://www.notebookcheck.net/AMD-Ryzen-7000-series-of-processors-unleashed-with-new-Zen-4-architecture-13-IPC-uplift-up-to-170-W-TDP-and-an-attractive-price-tag.643775.0.html) . NotebookCheck. Retrieved 9 November 2022.

16. Anthony, Sebastian; Walton, Mark (13 December 2016). "AMD's Zen CPU is now called Ryzen, and it might actually challenge Intel" (https://arstechnica.com/gadgets/2016/12/amd-zen-performance-details-release-date/) . *Ars Technica*. Retrieved June 26, 2018.

17. Murray, Matthew (8 January 2018). "AMD's New Desktop Processors for 2018: What You Need to Know" (https://www.tomsguide.com/us/amd-ryzen-2-faq,news-26346.html) . Tom's Guide. Retrieved June 26, 2018.

18. Cuttress, Ian (March 2, 2017). "The AMD Zen and Ryzen 7 Review: A Deep Dive on 1800X, 1700X and 1700" (http://www.anandtech.com/show/11170/the-amd-zen-and-ryzen-7-review-a-deep-dive-on-1800x-1700x-and-1700/23) . *AnandTech*. p. 23. Retrieved September 4, 2017.

19. "[PATCH] add znver1 processor" (https://sourceware.org/ml/binutils/2015-03/msg00078.html) .

20. Leather, Antony. "AMD Ryzen Threadripper: The Fascinating Story Behind The Processor That Beat Intel" (https://www.forbes.com/sites/antonyleather/2017/09/05/amd-ryzen-threadripper-the-fascinating-story-behind-the-processor-that-beat-intel/) . Forbes. Retrieved 2020-01-06.

21. Tucker, Laura (7 December 2023). "AI Is Hitting Your Computer Hardware: AMD Ryzen AI" (https://www.maketecheasier.com/amd-ryzen-ai/) . *Make Tech Easier*. Retrieved 26 March 2024.

22. Hachman, Mark (15 May 2023). "Why AMD thinks Ryzen AI will be just as vital as CPUs and GPUs" (https://www.pcworld.com/article/1815008/why-amd-thinks-ryzen-xdna-ai-is-the-future.html) . *PCWorld*. Retrieved 26 March 2024.

23. Bonshor, Gavin (6 December 2023). "AMD Widens Availability of Ryzen AI Software For Developers, XDNA 2 Coming With Strix Point in 2024" (https://www.anandtech.com/show/21178/amd-widens-availability-of-ryzen-ai-software-for-developers-xdna-2-coming-with-strix-point-in-2024) . *www.anandtech.com*. Retrieved 26 March 2024.

24. Larabel, Michael (25 January 2024). "AMD Publishes XDNA Linux Driver: Support For Ryzen AI On Linux" (https://www.phoronix.com/news/AMD-XDNA-Linux-Driver-Ryzen-AI) . *www.phoronix.com*. Retrieved 26 March 2024.

25. Cutress, Ian (March 2, 2017). "The AMD Zen and Ryzen 7 Review: A Deep Dive on 1800X, 1700X and 17000" (http://www.anandtech.com/show/11170/the-amd-zen-and-ryzen-7-review-a-deep-dive-on-1800x-1700x-and-1700) . *AnandTech*. Retrieved March 16, 2017.

26. Johnson, Renee (March 2, 2017). "AMD's Ryzen 7 1800X, Ryzen 7 1700X, and Ryzen 7 1700 CPUs reviewed" (http://techreport.com/review/31366/amd-ryzen-7-1800x-ryzen-7-1700x-and-ryzen-7-1700-cpus-reviewed/) . Tech Report. Retrieved March 3, 2017.
27. "AMD Ryzen 7 1800X och 7 1700X- Sweclockers" (http://www.sweclockers.com/test/23426-amd-ryzen-7-1800x-och-7-1700x/5) . *Sweclockers.com*.
28. Hagedoom, Hilbert (March 2, 2017). "AMD Ryzen 7 1800X Review - CPU-Z Screenshots & System" (http://www.guru3d.com/articles-pages/amd-ryzen-7-1800x-processor-review,7.html) . *The Guru of 3D*. Retrieved November 28, 2022.
29. "Gaming: Tips for Building a Better AMD Ryzen System" (http://community.amd.com/community/gaming/blog/2017/03/14/tips-for-building-a-better-amd-ryzen-system) . *AMD Community*. March 15, 2017. Retrieved March 15, 2017.
30. Walton, Mark (March 2, 2017). "AMD Ryzen 7 1800X still behind Intel, but it's great for the price" (https://arstechnica.com/gadgets/2017/03/amd-ryzen-review) . *Ars Technica*. Retrieved March 3, 2017.
31. Alcorn, Paul (March 2, 2017). "AMD Ryzen 7 1800X CPU Review" (http://www.tomshardware.com/reviews/amd-ryzen-7-1800x-cpu,4951-2.html) . *Tom's Hardware*. Retrieved March 3, 2017.
32. Verry, Tim (March 4, 2017). "PSA: AMD XFR Enabled On All Ryzen CPUs, X SKUs Have Wider Range" (https://www.pcper.com/news/Processors/PSA-AMD-XFR-Enabled-All-Ryzen-CPUs-X-SKUs-Have-Wider-Range) . *PC Perspective*. Retrieved February 3, 2018.
33. Hallock, Robert (1 April 2019). "AMD Ryzen Processor Features Defined" (https://www.reddit.com/comments/b8a5ft) . Reddit. Retrieved November 28, 2022.
34. Singh, Karandeep (February 21, 2017). "AMD Ryzen 7 Getting More Interesting, New Wraith RGB Coolers and Box Design Revealed" (http://www.racingjunky.com/amd-ryzen-7-getting-interesting-new-wraith-rgb-coolers-box-design-revealed/) . *Racing Junky*. Retrieved November 28, 2022.
35. Federowicz, Evan (21 December 2019). "First-Gen AMD Ryzen CPUs are Appearing with 12nm Zen+ Architecture" (https://wccftech.com/first-gen-amd-ryzen-cpus-are-appearing-with-12nm-zen-architecture/) . Wccftech. Retrieved November 28, 2022.
36. Alcorn, Paul (April 13, 2018). "AMD Announces 2nd Generation Ryzen 7 & 5 CPUs: Pricing, Pre-Orders" (http://www.tomshardware.com/news/amd-pinnacle-ridge-ryzen-pre-order,36878.html) . Tom's Hardware. Retrieved April 13, 2018.
37. Hallock, Robert (November 27, 2017). "Understanding Precision Boost 2 in AMD SenseMI technology" (https://community.amd.com/community/gaming/blog/2017/11/27/asdasd) . *AMD*. Retrieved November 28, 2022.
38. "AMD's 2018 roadmap: Desktop APUs in February, second-generation Ryzen in April" (https://arstechnica.com/gadgets/2018/01/amds-2018-roadmap-desktop-apus-in-february-second-generation-ryzen-in-april/) . Ars Technica. January 8, 2018. Retrieved January 16, 2018.

39. Shrout, Ryan (May 30, 2017). "Computex 2017: AMD Demos Ryzen Mobile SoC with Vega Graphics" (https://www.pcper.com/news/Processors/Computex-2017-AMD-Demos-Ryzen-Mobile-SoC-Vega-Graphics) . *PC Perspective*. Retrieved June 2, 2017.

40. Cutress, Ian (October 26, 2017). "Ryzen Mobile is Launched" (https://www.anandtech.com/show/11964/ryzen-mobile-is-launched-amd-apus-for-laptops-with-vega-and-updated-zen) . AnandTech. Retrieved October 26, 2017.

41. "The Mobile CPU Comparison Guide Rev. 13.0 Page 5 : AMD Mobile CPU Full List" (https://www.techarp.com/guides/mobile-cpu-comparison-guide/5/) . *TechARP*. Retrieved 13 December 2017.

42. Alcorn, Paul (February 21, 2018). "AMD Launches Ryzen Embedded V1000, EPYC Embedded 3000 Processors" (http://www.tomshardware.com/news/amd-epyc-ryzen-embedded-v1000-3000,36556.html) . *Tom's Hardware*. Retrieved April 5, 2018.

43. "AMD Expands Embedded Product Family, Adds Design Wins and Customers, with New Ryzen Embedded R1000" (https://www.amd.com/en/press-releases/2019-04-16-amd-expands-embedded-product-family-adds-design-wins-and-customers-new) . *AMD*. April 16, 2019. Retrieved August 8, 2019.

44. Cutress, Ian (June 10, 2019). "AMD Zen 2 microarchitecture analysis: Ryzen 3000 and EPYC Rome" (https://www.anandtech.com/show/14525/amd-zen-2-microarchitecture-analysis-ryzen-3000-and-epyc-rome) . *AnandTech*. Retrieved November 18, 2022.

45. Cutress, Ian (January 9, 2019). "AMD Ryzen 3rd Gen 'Matisse' Coming Mid 2019: Eight Core Zen 2 with PCIe 4.0 on Desktop" (https://www.anandtech.com/show/13829/amd-ryzen-3rd-generation-zen-2-pcie-4-eight-core) . *AnandTech*. Retrieved November 28, 2022.

46. Cutress, Ian (September 20, 2019). "AMD: Next Gen Threadripper and Ryzen 9 3950X, Coming November" (https://www.anandtech.com/show/14895/amd-next-gen-threadripper-and-ryzen-9-3950x-coming-november) . *AnandTech*. Retrieved November 28, 2022.

47. Cutress, Ian (June 10, 2019). "AMD Ryzen 3000 APUs: Up to Vega 11, More MHz, Under $150, Coming July 7th" (https://www.anandtech.com/show/14523/amd-ryzen-3000-apus-up-to-vega-11-more-mhz-under-150) . *AnandTech*. Retrieved November 18, 2022.

48. Cutress, Ian (21 July 2020). "AMD Launches 12 Desktop Renoir Ryzen 4000G Series APUs: But You Can't Buy Them" (https://www.anandtech.com/show/15921/amd-launches-12-desktop-renoir-ryzen-4000g-series-apus-but-you-cant-buy-them) . *AnandTech*. Retrieved 26 April 2021.

49. "Ryzen 3 PRO 4350G" (https://www.amd.com/en/products/apu/amd-ryzen-3-pro-4350g) . AMD. Retrieved 28 November 2022.

50. Mann, Parm (15 March 2022). "AMD launches seven new Ryzen CPUs as part of extensive desktop overhaul" (https://www.club386.com/amd-launches-seven-new-ryzen-cpus-as-part-of-extensive-desktop-overhaul/) . *Club386*. Retrieved 7 July 2023.

51. Cutress, Ian (6 January 2020). "AMD Ryzen 4000 Mobile APUs: 7nm, 8-core on both 15W and 45W, Coming Q1" (https://www.anandtech.com/show/15324/amd-ryzen-4000-mobile-apus-7nm-8core-on-both-15w-and-45w-coming-q1) . *AnandTech*. Retrieved January 7, 2020.

52. Alcorn, Paul (January 7, 2020). "AMD Launches Threadripper 3990X and Ryzen 4000 'Renoir' APUs" (https://www.tomshardware.com/news/amd-launches-threadripper-3990x-and-ryzen-4000-renoir-apus) . Tom's Hardware. Retrieved January 7, 2020.

53. Gartenberg, Chaim (6 January 2020). "AMD's 7nm Ryzen 4000 CPUs are here to take on Intel's 10nm Ice Lake laptop chips" (https://www.theverge.com/2020/1/6/21054007/amd-7nm-ryzen-4000-cpu-ces-2020-intel-competition-laptop-processors-zen-2) . The Verge. Retrieved January 7, 2020.

54. Abazovic, Fuad (20 May 2020). "Ryzen 4000 desktop was planned for Computex 2020" (https://www.fudzilla.com/news/pc-hardware/50863-ryzen-4000-desktop-was-planned-for-computex-2020) . Fudzilla. Retrieved November 28, 2022.

55. Hruska, Joel (January 10, 2020). "AMD's Lisa Su Confirms Zen 3 Coming in 2020, Talks Challenges in Notebooks" (https://www.extremetech.com/computing/304541-amds-lisa-su-confirms-zen-3-coming-in-2020-talks-challenges-in-notebooks) . ExtremeTech. Retrieved November 28, 2022.

56. Cutress, Ian (October 16, 2020). "AMD Zen 3: An AnandTech Interview with CTO Mark Papermaster" (https://www.anandtech.com/show/16176/amd-zen-3-an-anandtech-interview-with-cto-mark-papermaster) . *AnandTech*. Retrieved November 28, 2022.

57. Subramaniam, Vaidyanathan (2022-03-08). "AMD launches Ryzen Threadripper Pro 5000 WX series led by the 5995WX that trounces two Intel Xeon Platinum 8280s" (https://www.notebookcheck.net/AMD-launches-Ryzen-Threadripper-Pro-5000-WX-series-led-by-the-5995WX-that-trounces-two-Intel-Xeon-Platinum-8280s.607070.0.html) . *Notebookcheck*. Retrieved 2023-03-06.

58. Hagedoorn, Hilbert (July 24, 2019). "Ryzen Threadripper 4000 Codename - AMD Genesis (and Vermeer): spotted in AIDA64" (https://www.guru3d.com/news-story/ryzen-threadripper-4000-codename-amd-genesis-(and-vermeer)-spotted-in-aida64.html) . Guru3D.com. Retrieved 2023-03-06.

59. Cutress, Ian (13 April 2021). "AMD Ryzen 5000G APUs: OEM Only For Now, Full Release Later This Year" (https://www.anandtech.com/show/16616/amd-ryzen-5000g-apus-oem-only-for-now-full-release-later-this-year) . *AnandTech*. Retrieved 26 April 2021.

60. "AMD Ryzen Processors with PRO Technologies" (https://www.amd.com/en/products/ryzen-pro-processors-laptop) . *AMD*. Retrieved 28 November 2022.

61. "AMD confirms Zen4 & Ryzen 7000 series lineup: Raphael in 2022, Dragon Range and Phoenix in 2023" (https://videocardz.com/newz/amd-confirms-zen4-ryzen-7000-series-lineup-raphael-in-2022-dragon-range-and-phoenix-in-2023) . VideoCardz. May 3, 2022. Retrieved May 3, 2022.

62. Liu, Zhiye (May 3, 2022). "AMD Confirms Zen 4 Dragon Range, Phoenix APUs for 2023" (https://www.tomshardware.com/news/amd-confirms-zen-4-dragon-range-phoenix-apus-for-2023) . *Tom's Hardware*. Retrieved July 3, 2022.

63. "AMD Ryzen 5 7500F im Test/Review" (https://www.pcmasters.de/) (in German). PCMasters. 18 August 2023. Retrieved 2023-09-19.

64. "AMD Ryzen 7000 "Zen4" desktop series launch September 27th, Ryzen 9 7950X for 699 USD" (https://videocardz.com/newz/amd-ryzen-7000-zen4-desktop-series-launch-september-27th-ryzen-9-7950x-for-699-usd) . VideoCardz. August 29, 2022. Retrieved August 30, 2022.

65. Bonshor, Gavin (23 May 2022). "AMD Ryzen 7000 Announced: 16 Cores of Zen 4, Plus PCIe 5 and DDR5 for Socket AM5, Coming This Fall" (https://www.anandtech.com/show/17399/amd-ryzen-7000-announced-zen4-pcie5-ddr5-am5-coming-fall) . AnandTech. Retrieved November 18, 2022.

66. Alcorn, Paul (September 30, 2022). "AMD Zen 4 Ryzen 7000 Specs, Release Date, Benchmarks, Price Listings" (https://www.tomshardware.com/news/amd-zen-4-ryzen-7000-release-date-specifications-pricing-benchmarks-all-we-know-specs) . *Tom's Hardware*. Retrieved November 18, 2022.

67. Gamers Nexus (May 23, 2022). *AMD's 5+GHz 16-Core Zen 4 CPUs, X670 & B650, Ryzen 7000 & 6000, & AM5* (https://www.youtube.com/watch?v=QZdScv4zxXM) . *YouTube*. Retrieved May 23, 2022.

68. Bonshor, Gavin (May 26, 2022). "AMD Corrects Socket AM5 Power Specifications: 170 W TDP and 230 W PPT" (https://www.anandtech.com/show/17418/amd-corrects-socket-am5-power-specifications-170w-tdp-and-230w-ppt) . *AnandTech*. Retrieved July 3, 2022.

69. Hachman, Mark (19 October 2023). "AMD's monstrous Threadripper 7000 CPUs aim for desktop PC dominance" (https://www.pcworld.com/article/2109168/amds-monstrous-threadripper-7000-returns-to-desktop-pcs.html) . *PCWorld*. Retrieved 10 January 2024.

70. Roach, Jacob (20 November 2023). "AMD isn't competing with Intel anymore -- Threadripper wins" (https://www.digitaltrends.com/computing/amd-threadripper-7000-review/) . *Digital Trends*. Retrieved 10 January 2024.

71. Hachman, Mark (20 September 2022). "AMD Ryzen 7020 'Mendocino' CPUs want low-cost laptops to last all day long" (https://www.pcworld.com/article/1070314/amd-ryzen-7020-mendocino-cpus-budget-laptops.html) . *PCWorld*. Retrieved 24 April 2023.

72. Prasad (5 January 2023). "AMD announces new Ryzen 7000 desktop and mobile CPUs" (https://www.gsmarena.com/amd_announces_new_ryzen_7000_desktop_and_mobile_cpus-news-57090.php) . *GSMArena.com*. Retrieved 26 April 2023.

73. Connatser, Matthew (5 January 2023). "AMD unveils Ryzen 7000 mobile APUs, V-Cache chips, and RX 7000 laptop GPUs" (https://www.xda-developers.com/amd-ryzen-7000-radeon-7000-mobile-ces-2023/) . *XDA Developers*. Retrieved 26 April 2023.

74. Hardawar, Devindra (4 January 2023). "AMD's Ryzen 7000 mobile CPUs feature up to 16 cores and 5.4GHz speeds" (https://www.engadget.com/amds-ryzen-7000-mobile-cpus-16-core-033046361.html) . *Engadget*. Retrieved 26 April 2023.

75. Bonshor, Gavin. "AMD Announces Ryzen Mobile 7045 HX-Series CPUs, Up to 16-Cores and 5.4 GHz for Laptops" (https://www.anandtech.com/show/18716/amd-announces-ryzen-7045-hx-series-cpus-for-laptops-up-to-16-cores-and-5-4-ghz) . *www.anandtech.com*. Retrieved 2023-01-09.

76. "AMD Ryzen 7000 Mobile: RDNA 3 in der Zen-4-APU und 16 Kerne per Chiplet-Ansatz" (https://www.computerbase.de/2023-01/amd-ryzen-7000-mobile-rdna-3-in-der-zen-4-apu-und-16-kerne-per-chiplet-ansatz/) . *computerbase.de* (in German). ComputerBase. 2023-01-05. Retrieved 2023-04-08.

77. Woods, Rich (7 September 2022). "Only some of AMD's Ryzen 7000 mobile processors will be Zen 4" (https://www.xda-developers.com/amd-ryzen-7000-mobile-naming/) . *XDA Developers*. Retrieved 24 April 2023.

78. Hachman, Mark (5 April 2023). "AMD's ridiculously complex Ryzen names make buying a laptop hard" (https://www.pcworld.com/article/1445760/amds-mobile-ryzen-naming-scheme-is-stupidly-complex.html) . *PCWorld*. Retrieved 17 April 2023.

79. White, Monica (4 April 2023). "AMD's Ryzen 7000 lineup is confusing, but at least we get a sticker" (https://www.digitaltrends.com/computing/amd-confusing-naming-scheme-for-mobile-cpus/) . *Digital Trends*. Retrieved 17 April 2023.

80. "AMD's New Ryzen Mobile CPU Naming Scheme Explained" (https://beebom.com/amd-ryzen-mobile-cpu-new-naming-scheme-explained/) . *Beebom*. 12 September 2022. Retrieved 24 April 2023.

81. Cunningham, Andrew (8 January 2024). "AMD launches Ryzen 8000G desktop CPUs, with updated iGPUs and AI acceleration" (https://arstechnica.com/gadgets/2024/01/integrated-gpus-in-ryzen-8000g-desktop-cpus-compete-with-low-end-graphics-cards/) . *Ars Technica*. Retrieved 10 January 2024.

82. Bonshor, Gavin (January 8, 2024). "AMD Unveils Ryzen 8000G Series Processors: Zen 4 APUs For Desktop with Ryzen AI" (https://www.anandtech.com/show/21208/amd-unveils-ryzen-8000g-series-processors-zen-4-apus-for-desktop-with-ryzen-ai) . *www.anandtech.com*. Retrieved 10 January 2024.

83. Klotz, Aaron (11 April 2024). "AMD quietly confirms worldwide launch for Ryzen 7 8700F, Ryzen 5 8400F — official specs revealed" (https://www.tomshardware.com/pc-components/cpus/amd-quietly-confirms-worldwide-launch-for-ryzen-7-8700f-ryzen-5-8400f-official-specs-revealed) . *Tom's Hardware*. Retrieved 12 April 2024.

84. Cunningham, Andrew (6 December 2023). "AMD's new Ryzen 8040 laptop chips look a lot like the Ryzen 7040 CPUs" (https://arstechnica.com/gadgets/2023/12/amds-new-ryzen-8040-laptop-chips-look-a-lot-like-the-ryzen-7040-cpus/) . *Ars Technica*. Retrieved 10 January 2024.

85. Bonshor, Gavin (6 December 2023). "AMD Unveils Ryzen 8040 Mobile Series APUs: Hawk Point with Zen 4 and Ryzen AI" (https://www.anandtech.com/show/21177/amd-unveils-ryzen-8040-mobile-series-apus-hawk-point-with-zen-4-and-ryzen-ai) . *www.anandtech.com*. Retrieved 10 January 2024.

86. Shilov, Anton (2024-04-10). "AMD's Zen 5 Ryzen 9000-series looms — latest chipset drivers add support" (https://www.tomshardware.com/pc-components/cpus/amds-zen-5-ryzen-9000-series-looms-latest-chipset-drivers-add-support) . *Tom's Hardware*. Retrieved 2024-04-15.

87. Syed, Areej (2024-02-18). "AMD Ryzen 9000 Specs and Release Date: Everything About Zen 5 (Updated)" (https://www.hardwaretimes.com/amd-ryzen-9000-release-zen-5/) . *Hardware Times*. Retrieved 2024-04-15.

88. Cutress, Ian (March 2, 2017). "The AMD Zen and Ryzen 7 Review" (http://www.anandtech.com/show/11170/the-amd-zen-and-ryzen-7-review-a-deep-dive-on-1800x-1700x-and-1700) . *AnandTech*. Retrieved June 23, 2017.

89. Kampman, Jeff (March 2, 2017). "AMD's Ryzen 7 1800X, Ryzen 7 1700X, and Ryzen 7 1700 CPUs reviewed" (https://techreport.com/review/31366/amd-ryzen-7-1800x-ryzen-7-1700x-and-ryzen-7-1700-cpus-reviewed) . *Tech Report*. Retrieved June 23, 2017.

90. Shrout, Ryan (March 2, 2017). "The AMD Ryzen 7 1800X Review: Now and Zen" (https://www.pcper.com/reviews/Processors/AMD-Ryzen-7-1800X-Review-Now-and-Zen) . *PC Perspective*. Retrieved June 23, 2017.

91. Lillah, Sarmad (September 28, 2020). "In Order For AMD Ryzen To Deliver In Performance AMD Needs Game Developers To Optimize Game Accordingly" (https://segmentnext.com/2017/03/03/amd-ryzen-performance/) . *Segment Next*. Retrieved November 28, 2022.

92. Ung, Gordon (March 2, 2017). "Ryzen review: AMD is back" (http://www.pcworld.com/article/3176191/computers/ryzen-review-amd-is-back.html?page=2) . *PCWorld*. Retrieved March 2, 2017.

93. Hruska, Joel (March 2, 2017). "AMD Ryzen 7 1800X reviewed: Zen is an amazing workstation chip with a 1080p gaming Achilles heel" (https://www.extremetech.com/gaming/245204-amds-ryzen-7-1800x-reviewed-zen-amazing-workstation-chip-1080p-gaming-achilles-heel) . *ExtremeTech*. Retrieved November 18, 2022.

94. "Didn't Attend AMD's Ryzen Reddit AMA? Here's What You Missed!" (https://www.custompcreview.com/news/didnt-attend-amds-ryzen-reddit-ama-heres-missed/39018/) . *Custom PC Review*. March 3, 2017.

95. Shrout, Ryan (March 29, 2017). "Ashes of the Singularity Gets Ryzen Performance Update" (https://www.pcper.com/reviews/Processors/Ashes-Singularity-Gets-Ryzen-Performance-Update) . *PC Perspective*. Retrieved March 30, 2017.

96. Shrout, Ryan (May 30, 2017). "Rise of the Tomb Raider Gets a Ryzen Performance Update" (https://www.pcper.com/reviews/Graphics-Cards/Rise-Tomb-Raider-Gets-Ryzen-Performance-Update) . *PC Perspective*. Retrieved May 31, 2017.

97. Killian, Zak (April 26, 2017). "id software talks about Ryzen" (https://techreport.com/news/31799/id-software-talks-about-ryzen) . *Tech Report*. Retrieved April 26, 2017.

98. "AMD's Ryzen CPU Series will Need Modern Linux Kernel for Proper Support" (https://www.techpowerup.com/231073/amds-ryzen-cpu-series-will-need-modern-linux-kernel-for-proper-support) . *TechPowerUp*. February 28, 2017. Retrieved November 18, 2022.

99. "AMD: Ryzen CPU gaming performance inhibited by lack of optimization" (https://www.yahoo.com/tech/amd-ryzen-cpu-gaming-performance-180809697.html) . *Yahoo!*. Retrieved November 18, 2022.

100. Moammer, Khalid (March 8, 2017). "AMD Ryzen Performance Negatively Affected by Windows 10 Scheduler Bug" (http://wccftech.com/amd-ryzen-performance-negatively-affected-windows-10-scheduler-bug/) . *Wccftech*. Retrieved November 18, 2022.

101. "AMD Ryzen Community Update" (https://community.amd.com/community/gaming/blog/2017/03/13/amd-ryzen-community-update?sf62107357=1) . *AMD*. Retrieved March 13, 2017.

102. Malventano, Allyn (March 10, 2017). "AMD Ryzen and the Windows 10 Scheduler - No Silver Bullet" (https://www.pcper.com/reviews/Processors/AMD-Ryzen-and-Windows-10-Scheduler-No-Silver-Bullet) . *PC Perspective*. Retrieved March 13, 2017.

103. Whitwam, Ryan (April 20, 2017). "Unofficial Patch Unblocks Windows 7 and 8.1 Updates for Kaby Lake, Ryzen" (https://www.extremetech.com/computing/248069-unofficial-patch-unblocks-windows-7-8-1-updates-kaby-lake-ryzen) . *ExtremeTech*. Retrieved September 3, 2017.

104. Hollister, Sean (September 21, 2021). "Windows 11 won't stop older PCs, but it might make you sign this waiver" (https://www.theverge.com/2021/9/21/22686457/windows-11-health-check-compatible-supported-cpu-old-pc-waiver) . *The Verge*. Archived (https://web.archive.org/web/20210921213708/https://www.theverge.com/2021/9/21/22686457/windows-11-health-check-compatible-supported-cpu-old-pc-waiver) from the original on September 21, 2021. Retrieved September 22, 2021.

105. Hollister, Sean (August 28, 2021). "Microsoft is threatening to withhold Windows 11 updates if your CPU is old" (https://www.theverge.com/2021/8/28/22646035/microsoft-windows-11-iso-workaround-no-update-guarantee) . *The Verge*. Archived (https://web.archive.org/web/20210922214012/https://www.theverge.com/2021/8/28/22646035/microsoft-windows-11-iso-workaround-no-update-guarantee) from the original on September 22, 2021. Retrieved September 22, 2021.

106. "Windows 11 Supported AMD Processors" (https://docs.microsoft.com/en-us/windows-hardware/design/minimum/supported/windows-11-supported-amd-processors) . *Microsoft*. Retrieved June 28, 2021.

107. Hachman, Mark (February 8, 2017). "AMD: Sorry, there will be no official Ryzen drivers for Windows 7" (http://www.pcworld.com/article/3167279/computers/amd-sorry-there-will-be-no-official-ryzen-drivers-for-windows-7.html) . *PCWorld*. Retrieved April 23, 2017.

108. "Chipset" (https://www.amd.com/en/support) . *support.amd.com*. Retrieved 2018-11-05.

109. Chacos, Brad (March 13, 2017). "Kernel 4.10 gives Linux support for AMD Ryzen multithreading" (http://www.pcworld.com/article/3176323/linux/kernel-410-gives-linux-support-for-zen-multithreading.html) . *PCWorld*. Retrieved June 28, 2017.

110. "Security Vulnerability: "Meltdown" and "Spectre" side channel attacks against CPUs with speculative execution" (https://www.suse.com/support/kb/doc/?id=7022512) . *www.suse.com*.

111. Larabel, Michael (December 2, 2020). "The Spectre Mitigation Performance Impact On AMD Ryzen 5000 "Zen 3" Processors" (https://www.phoronix.com/scan.php?page=article&item=zen-3-spectre&num=5) . *Phoronix*. Retrieved November 28, 2022.

112. Larabel, Michael (August 30, 2018). "The Spectre Mitigation Performance Impact On AMD Ryzen 5000 "Zen 3" Processors" (https://www.phoronix.com/scan.php?page=article&item=linux-419-mitigations&num=4) . *Phoronix*. Retrieved November 18, 2022.

113. Larabel, Michael (November 16, 2018). "Bisected: The Unfortunate Reason Linux 4.20 Is Running Slower" (https://www.phoronix.com/scan.php?page=article&item=linux-420-bisect&num=1) . *Phoronix*. Retrieved November 28, 2022.

114. "AMD Processor Security" (https://www.amd.com/en/corporate/security-updates) . *AMD*. Retrieved November 28, 2022.

115. btarunr (June 12, 2019). "AMD Zen 2 has Hardware Mitigation for Spectre V4" (https://www.techpowerup.com/256478/amd-zen-2-has-hardware-mitigation-for-spectre-v4) . *TechPowerUp*. Retrieved October 18, 2019.

116. Larabel, Michael (August 7, 2017). "AMD Confirms Linux Performance Marginality Problem Affecting Some, Doesn't Affect Epyc" (https://www.phoronix.com/scan.php?page=news_item&px=Ryzen-Segv-Response/) . *Phoronix*. Retrieved November 28, 2022.

117. Hruska, Joel (August 29, 2017). "AMD Replaces Ryzen CPUs for Users Affected By Rare Linux Bug" (https://www.extremetech.com/computing/254750-amd-replaces-ryzen-cpus-users-affected-rare-linux-bug.) . *ExtremeTech*. Retrieved November 18, 2022.

118. Cimpanu, Catalin (March 13, 2018). "AMD Investigating RyzenFall, MasterKey, Fallout, and Chimera CPU Vulnerabilities" (https://www.bleepingcomputer.com/news/security/amd-investigating-ryzenfall-masterkey-fallout-and-chimera-cpu-vulnerabilities/) . *Bleeping Computer*. Retrieved June 12, 2018.

119. Mott, Nathaniel (March 14, 2018). "CTS Labs Speaks: Why It Blindsided AMD With Ryzenfall And Other Vulnerabilities" (https://www.tomshardware.com/news/cts-labs-amd-ryzenfall-ryzen-epyc,36660.html) . *Tom's Hardware*. Retrieved November 18, 2022.

120. Cutress, Ian (March 13, 2018). "Security Researchers Publish Ryzen Flaws, Gave AMD 24 hours Prior Notice" (https://www.anandtech.com/show/12525/security-researchers-publish-ryzen-flaws-gave-amd-24-hours-to-respond) . *AnandTech*. Retrieved November 28, 2022.

121. Hachman, Mark (March 19, 2018). "AMD's Ryzen, Epyc security co-processor and chipset have major flaws, researchers claim" (https://www.pcworld.com/article/3262967/amds-ryzen-epyc-security-co-processor-and-chipset-have-major-flaws-researchers-claim.html) . *PCWorld*. Retrieved November 18, 2022.

122. Wagner, Jayce (March 20, 2018). "AMD is working on fixes for the reported Ryzenfall, MasterKey vulnerabilities" (https://www.digitaltrends.com/computing/amd-ryzenfall-vulnerabilties/) . *Digital Trends*. Retrieved June 26, 2018.